Claims

1. A method for determining the authenticity of an object, the method comprising the steps of:

   - receiving an authentication code,

   - determining if particles are distributed within the object in a three-dimensional pattern,

   - determining the positions of particles distributed in the object,

   - using the determination of the positions to provide a check-code,

   - using the check-code and the authentication-code to determine the authenticity of the object.

2. The method of claim 1, wherein the positions of the particles are determined using a two-dimensional image of the object.

3. The method of claim 1 ~~or 2~~, the determination if the particles are distributed in a three-dimensional pattern comprising the steps of:

   - acquiring of a first image of the object with a first angle of illumination,

   - acquiring a second image of the object with a second angle of illumination,

   - combining the first and second images,

- determining if a geometrical artefact is present in the combined images.

4. The method of claim 1,~~2 or 3,~~ wherein the determination if the particles are distributed in a three-dimensional pattern is made by determining if the object is reflective.

5. The method of claim 4, wherein it is determined whether the object is reflective by acquiring a first image with diffuse illumination of the object and acquiring a second image with direct illumination of the object and comparing a brightness of the object in the first and second images.

6. The method of ~~any one of the preceding claims 1 to 5,~~claim 1, the determination if the particles are distributed in a three-dimensional pattern comprising:

- illuminating the object with diffuse, white light,

- detecting light reflected from the object and light transmitted through the object, and

- determining, if the reflected light and the transmitted light have complementary colours.

7. The method of ~~any one of the preceding claims 1 to 6,~~claim 1, further comprising:

- acquiring an image of the object in a read position,

- determining a dislocation of the read position with respect to a reference position by detecting marker positions in the image, and

- performing a projective transformation of the image for compensation of the dislocation.

8. The method of ~~any one of claims 1 to 7,~~claim 1, the check code being provided by:

- determining the positions of the particles,

- using the positions to provide the check code.

9. The method of claim 8, wherein the positions of the particles are determined using a two-dimensional image of the object and wherein the check code is provided by encoding of the positions.

10. The method of claim 9, further comprising determining a polynomial based on the positions, wherein the encoding of the positions is performed by dividing the polynomial by a generator polynomial.

11. The method of claim 10, wherein the polynomial is determined by sorting the positions using a sorting criterion and using the sorted positions to obtain the polynomial.

12. The method of claim 11, wherein the sorting criterion is applied to first coordinate values of the positions, and wherein only the second coordinate values of the sorted positions are used to obtain the polynomial.

13. The method of claim 12, wherein the polynomial is determined by shifting the second coordinate values by a pre-determined number of bit positions and by concatenating most significant bits of the shifted coordinate values in the order as determined by the sorting of the positions.

14. The method of ~~claims 8 or 9, wherein the encoding of the positions is performed~~claim 1, further comprising providing position data descriptive of the determined positions, and wherein the check-code is provided by encoding the position data by means of a hashing method.

15. An authentication device comprising:

- means~~(910, 912, 914)~~ for determining the positions of particles distributed within an object in a three-dimensional pattern,
- means~~(914)~~ for determining if particles are distributed within the object in three dimensions,
- means~~(916)~~ for encoding the determined positions to provide a check-code,
- means~~(918, 920)~~ for entering an authentication code,
- means~~(918)~~ for determining the authenticity of the object based on the check-code and the authentication code.

16. The authentication device of claim 15, wherein the means for determining the positions of the particles is adapted to determine the positions in two dimensions.

17. The authentication device of claim 15~~ or 16~~, wherein the means for determining if the particles are distributed in three dimensions is adapted to determine if the object is reflective.

18. The authentication device ~~of any one of claims 15, 16 or 17,~~claim 15, the means~~(910, 912, 914)~~ for determining the positions of particles comprising image processing means adapted to perform a projective transformation of

an image in order to compensate for a dislocation of the image with respect to a reference position.

19. The authentication device of claim 18, the image processing means being adapted to determine the dislocation by determining of marker positions in the image.

20. A card reader for authenticating a customer card ~~(904)~~, the customer card having an authentication label ~~(906)~~ carrying a three-dimensional pattern of randomly distributed particles, the card reader ~~comprising:~~

~~- apparatus for determining if the particles are distributed within the object in three dimensions (910, 912, 914) and for determining the positions of particles,~~

~~- an encoder (916) for encoding of the determined positions to provide a check-code,~~

~~- an interface (918, 920) for receiving an authentication code,~~

~~- a processor (918) for determining the authenticity of the object based on the check-code and the authentication code.~~

~~21. An electronic device for reading a data carrier, the data carrier having a copy protection label (956), the copy protection label carrying a three-dimensional pattern of distributed particles, the electronic device~~ comprising:

- ~~an optical sensor (912)~~apparatus for determining if the particles are distributed within the ~~copy protection label~~object in three dimensions and for determining the positions of particles,

-

- an encoder~~(916)~~ for encoding of the determined positions to provide a check-code,

-

- an interface~~(918, 920)~~ for receiving an authentication code,

-

- a processor~~(918)~~ for determining the authenticity of the object based on the check-code and the authentication code.

21. An electronic device for reading a data carrier, the data carrier having a copy protection label, the copy protection label carrying a three-dimensional pattern of distributed particles, the electronic device comprising:

- an optical sensor for determining if the particles are distributed within the copy protection label in three dimensions and for determining the positions of particles,

- an encoder for encoding of the determined positions to provide a check-code,

- an interface for receiving an authentication code,

- a processor for determining the authenticity of the object based on the check-code and the authentication code.

22. An electronic device for authentication of an object comprising:

- an apparatus for determining if the object has a three-dimensional pattern of distributed particles,

- a measurement component for determining the positions of particles,

- an encoding apparatus for encoding the determined positions to provide a check-code,

- an interface for receiving an authentication code,

- a processor for determining the authenticity of the object based on the check-code and the authentication code.

23. The electronic device of claim 22, the measurement component comprising an image processing component.

24. The electronic device of claim 22 ~~or 23~~, the measurement component operable to determine the positions in two dimensions.

25. The electronic device of claim 22, ~~23, or 24,~~ the apparatus being adapted to determine if the object is reflective.

26. The electronic device of claim 22, the apparatus being operable to

- illuminate the object with diffuse, white light,

- detect light reflected from the object and light transmitted through the object, and

- determine if the reflected light and the transmitted light have complementary colours.

27. The electronic device of claim 22, further comprising:

- an image acquisition apparatus for acquiring an image of the object in a read position,

- an image processing apparatus for determining a dislocation of the read position with respect to a reference position by detecting marker positions in the image and for performing a projective transformation of the image for compensation of the dislocation.

28. The electronic device of claim 22, wherein the measurement component is adapted to determine the positions of the particles using a two-dimensional image of the object and the encoding apparatus being adapted to provide the check code by encoding the positions.

29. The electronic device of claim 28, the encoding apparatus operable to determine a polynomial based on the positions, wherein the encoding of the positions is performed by dividing the polynomial by a generator polynomial.